

Utility Model Patent Application Publication No. S50-79379

Utility Model Patent Application

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To: Patent Office Commissioner: Mr. Hideo Saito

1. Invention Title: Light Emitting Semiconductor Apparatus

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5. List of Attached Documents

- |    |                   |          |
|----|-------------------|----------|
| 1) | Specification     | One copy |
| 2) | Figures           | One set  |
| 3) | Power of Attorney | One copy |

## Specification

1. Invention Title: Light Emitting Semiconductor Apparatus

2. What is Claimed is:

A light emitting semiconductor apparatus which is equipped with a light emitting semiconductor device and a transparent cover which covers said light emitting semiconductor device across a gap, wherein there is a phosphor layer on a surface of said transparent cover which faces said light emitting semiconductor device.

3. Detailed Explanation of the Utility Model Invention

The present utility model invention relates to a light emitting semiconductor apparatus which employs a phosphor to produce a visible light emission.

Recently, semiconductor light emitting diodes are frequently utilized as compact display devices with a long life. Their emission wavelengths are determined by the band gap which is specific to the semiconductor materials employed. For example, light emitting diodes utilizing gallium arsenide which is relatively inexpensive have an emission wavelength in the infrared region. Therefore, they can not be utilized as display devices without modification, although they exhibit high emission efficiency. Thus, light emitting semiconductor apparatuses in which a visible light conversion phosphor is applied on the surface of such infrared light emission diodes are produced. For example, Examined Patent Publication No. S46-9194 discloses such a light emitting semiconductor apparatus.

These light emitting semiconductor apparatuses have high brightness. Semiconductor materials, however, are expensive and light emitting devices are made very small. Therefore, they have a disadvantage in that they are almost a point light source. On the other hand, techniques are employed in order to obtain a large light emission area, such as providing a transparent lens in front of a light emitting device, and covering a light emitting device with a resin containing a light scattering agent. Such light emitting apparatuses, however, have complex structures and are expensive. Moreover, they have a disadvantage in that intense emission is observed only in the

vicinity of a light emitting device although such a light scattering agent has an effect to reduce the overall light emitting intensity.

On the other hand, as disclosed in the aforementioned Examined Patent Publication No. S46-9194, a light emission area can be made larger if a binding agent in which a phosphor is dispersed is formed into a hemisphere covering a large region including a light emitting device, instead of applying the binding agent in a thin film on the surface of the light emitting device. A phosphor, however, is rather more expensive than semiconductor materials. Therefore, a structure which requires a large amount of phosphor is not preferred in terms of cost.

Upon giving reflections to the above points, the present utility model invention is intended to provide a light emitting semiconductor apparatus with a large light emitting area at low cost.

A light emitting semiconductor apparatus of the present utility model invention is equipped with a light emitting semiconductor device and a transparent cover which covers said light emitting semiconductor device across a gap, wherein there is a phosphor layer on a surface of said transparent cover which faces said light emitting semiconductor device.

Below, the present utility model invention is explained according to an example.

Figure 1 depicts a light emitting semiconductor apparatus of an example of the present utility model invention. In the example, the present utility model invention is applied to a light emitting semiconductor apparatus which employs a so-called TO-5 stem. Figure 1, glass 2 fixes leads 3 in a TO-5 metal stem 1. A light emitting semiconductor device 4 is conductively connected to stem 1. A transparent cover 6 according to the present utility model invention is fixed on stem 1. A phosphor layer 7 is provided by applying a binding agent in which a phosphor to convert the radiation from light emitting semiconductor device 4 to visible light is dispersed on the inner surface of transparent cover 6. Transparent cover 6 is made of a material such as glass or an epoxy resin is preferably fixed to stem 1 so that it can also function as a cap for hermetic sealing.

In the light emitting apparatus of the present utility model invention, phosphor layer 7 converts infrared or UV emitted from light emitting semiconductor device 4 to visible light which is radiated in random directions. Therefore, the light emitting

semiconductor apparatus can produce an emission with a uniform intensity over a large area. Further, the light emitting semiconductor apparatus utilizes a relatively small quantity of phosphor and hence, is inexpensive.

Another example of a light emitting semiconductor apparatus of the present utility model is illustrated in Figure 2. In this example, the present utility model invention is applied to a mold-type light emitting semiconductor apparatus. In Figure 2, leads 9 are fixed on an insulating base 8. On a tip of one lead 9, a light emitting semiconductor device 10 is electrically connected. Further, light emitting semiconductor device 10 and the other lead 9 are electrically connected through a lead wire 11. A transparent resin 12 forms a hemispherical mold around light emitting semiconductor device 10. A phosphor layer 13 is formed on the surface of transparent resin 12. Further, a transparent cover 14 made of a material such as a transparent resin is provided on phosphor layer 13. In the present example, a ceramic material or a resin can be utilized for insulating base 8. Moreover, insulating base 8 may be formed at the same time when hemispherical transparent resin 12 is molded after light emitting semiconductor device 10 is fixed on lead 9 and lead wire 11 is connected. It is known that transparent resin 12 protects light emitting semiconductor device 10 and that at the same time, it improves apparent light emission efficiency of light emitting semiconductor device 10. In other words, providing transparent resin 12 reduces a difference in the index of refraction between inside and outside of light emitting semiconductor device 10, thereby preventing light generated in the device from being totally reflected and enabling the light to efficiently exit the device. Because of these purposes, in general, an epoxy resin with a large index of refraction is frequently employed for transparent resin 12.

Phosphor layer 13 and transparent cover 14 can be formed by sequentially applying a fluorescent conversion paint and a transparent resin. In the present example, transparent cover 14 does not play a role as a cap for hermetic sealing, but is merely intended to protect phosphor layer 13.

As explained above, the present example of a light emitting semiconductor apparatus of the present utility model invention facilitate an emission over a large area. It does not require a large amount of phosphor and hence, can be produced in an inexpensive manner.

A light emitting semiconductor apparatus of the present utility model invention is not limited to the structures and materials illustrated in the above examples. For example, it goes without saying that a near UV light emitting devices with GaN can be employed and that an ordinary UV-visible light conversion phosphor can be utilized.

#### 4. Brief Explanation of the Figures

Figures 1 and 2 are a cross sections of examples of a light emitting semiconductor device of the present utility model invention, respectively.

In the figures, numeral 1 denotes a stem, numerals 3 and 9 denote leads, numerals 4 and 10 denote a light emitting semiconductor device, numerals 6 and 14 denote a transparent cover and numerals 7 and 13 denote a phosphor layer.

Patent Attorney: Hiroshirou Matsuoka

Figure 1

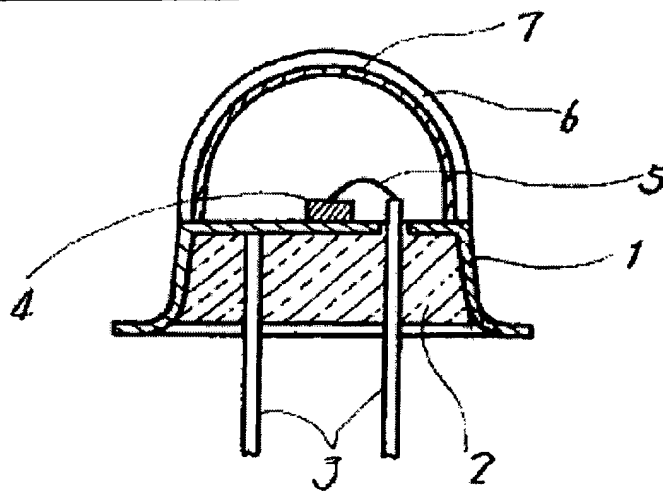


Figure 2

